United States
Department of
Agriculture

Forest Service

Pacific Northwest
Research Station

**University of Washington
Center for International
Trade in Forest Products**

Research Paper
PNW-364

July 1986

Potential Pacific Rim Demand for Construction-Grade Softwood Logs

Donald F. Flora and Richard P. Vlosky

Authors

DONALD F. FLORA is Research Economist, International Trade Research, Pacific Northwest Research Station, 4043 Roosevelt Way N.E., Seattle, Washington 98105.
RICHARD P. VLOSKY is Doctoral Candidate in Forest Economics, College of Forest Resources, University of Washington, Seattle, Washington 98195.

Abstract

Flora, Donald F.; Vlosky, Richard P. Potential Pacific Rim demand for construction-grade softwood logs. Res. Pap. PNW-364. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station; **1986.** 29 p.

Markets for small lower grade ("construction-grade"), softwood logs are projected to expand steadily through 1995. Log supplies will lag slightly behind demand until 1990, generating about a 10-percent increase in prices. Prices are expected to be level thereafter. United States exports of construction-grade logs are projected to increase 35 percent by 1990 and another 23 percent by 1995.

Keywords: Markets (external), supply/demand (forest products), trade (Pacific Rim).

Research Summary

"Construction-grade" logs are smaller, lower grade softwood roundwood logs that compete with U.S. number 3 coastal hemlock saw logs. Hemlock logs are 6 to 12 inches in diameter; construction-grade logs range to larger diameters. Projections of demand and supply for construction-grade logs were estimated for 1990 and 1995 for each supplying and consuming country around the Pacific Rim. Principal suppliers are expected to be Canada, Chile, New Zealand, United States, and Union of Soviet Socialist Republics. Expected purchasers are China, Japan, Korea, and Taiwan (a nonparticipant in softwood log trade until the mid-1980's).

Supply equations, estimated for each exporting country, were summed to an aggregate Pacific-wide supply function after adjustments were made for transportation costs, exchange rates, and inflation. A similar process was applied to demand. The aggregate supply and demand functions were then solved for equilibrium price and quantity for 1983—the base year and the last year for which a full complement of data was available. Next, the national equations were projected to 1990 and 1995 by use of shifters such as gross national product and harvest forecasts. Equilibriums were then estimated for those years.

The study produced log flow estimates of 1.72 billion board feet in 1983, 2.2 billion in 1990, and 2.5 billion in 1995. The indicated increases are 35 percent by 1990 and an additional 23 percent by 1995. Log prices, in U.S. dollars and at Pacific coast ports, are expected to increase from an average of $290 per thousand board feet in 1983 to $330 in 1990 and $338 in 1995.

For the United States, construction-grade log exports of 361 million board feet in 1983 were about 15 percent of all softwood log exports from the west coast. The U.S. estimate for 1990 is 488 million board feet; for 1995, 602 million.

These conclusions depend on a stable world economy and the return of exchange rates to about their 1983 levels. The conclusions are independent of inflation rates because they are expressed in real (1983) dollars.

Contents

Introduction

For at least two decades land managers have pondered the fate of timber at the low end of the value spectrum. Lodgepole pine (*Pinus contorta* Dougl. ex Loud.) and beetle-killed spruce (*Picea* spp.) in the central Rocky Mountains and the Columbia Basin, defective hemlock (*Tsuga* spp.) in the northern Rocky Mountains, white spruce (*P. glauca* (Moench) Voss) in interior British Columbia and interior Alaska, residual stands of hemlocks (*Tsuga* spp.) and Sitka spruce (*P. sitchensis* (Bong.) Carr.) in southeast Alaska, upper elevation Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) along the eastern slope of the Cascade Range, and "commercial" thinnings in the heart of the Douglas-fir region are all marketing challenges. They have excited interest during high parts of business cycles and despair during recessions.

This report is a country-by-country assessment of demand for such timber and competing supplies that will be offered on all sides of the Pacific Ocean. Demand and supply projections, from which estimates of price and quantities exchanged are taken, were made for 1990 and 1995.

The trees of this study have in common small size, high extraction costs because of poor access and small size, high manufacturing costs because of size, and in some places a significant component with heart rot. This material, which comprises a growing proportion of the timber resource as larger timber is harvested, varies also in ring width and knot size. Removed to the Orient, a portion of this resource is exploited as appearance-grade lumber; the value of that fraction is assumed to be offset by the proportion of small timber that falls into cull and utility grades because of its quality. In the woods, then, the timber evaluated in this study can be seen as clustered at the low ends in size, quality, and accessibility but nonetheless overlapping the large diameter components. For instance, a tree that is economically attractive in size and quality may be in an outlier stand or in a cutting unit's distant corner and thus will not pay its way out of the woods at the time the vicinity is logged. Such timber cannot be characterized precisely because tree grades built around economic worth are not in common use.

At the dock, where log grades can be assigned, the timber in this study is generally No. 3 saw logs, with scaling diameters between 6 and 12 inches and capable of producing at least one-third of the outturn in "standard" lumber grade or better. The study is specifically oriented to logs that are competitive with No. 3 hemlock saw logs from the Coast Range in Washington State. These hemlock saw logs, with relatively wider rings generated by productive sites, are called "coast grade" in the trade in Japan and elsewhere, contrasting with tighter grained "Cascade" (U.S.) logs. These "J-sort, coast" logs, exported primarily for general construction and structural uses not based on appearance, provide the benchmark values used in this study. Considered roughly comparable in value are the "K-sort" logs destined for Korea, typically woodsrun and averaging 9 inches or less in diameter. Also discussed are British Columbia No. 4 logs between 4 and 14 inches in diameter. Together, these lower value logs are called here "construction-grade" to distinguish them from larger, more valuable "structural-grade" logs that compete with U.S. No. 2 saw logs. Both strata are arbitrary, as more than 60 log grading assortments are recognized at the port of Grays Harbor alone.

Construction-grade logs from North America are expected to compete with radiata pine (*Pinus radiata* D. Don, also called Monterey and Insignis pine) from Chile and New Zealand, and all but the largest of Soviet softwood logs from eastern Siberia and the Soviet Union Far East, especially larch (*Larix* spp.). Construction-grade softwood logs embrace 35 percent of all softwood roundwood and sawn wood traded around the Pacific and 80 percent of all softwood log trade in that region.

The next section describes in general how log prices and overseas flows were projected for construction-grade logs. In the subsequent section is a discussion of economic conditions in each country that affect its timber supply or demand. Also explained are the assumptions made for each country. Too, the supply or demand outlook for each nation is portrayed graphically.

Composite results for the Pacific Rim, which determine estimated Rim-wide log prices and flows, are shown and discussed in the last section. The appendix contains the economic detail for each country.

How the Projections Were Made

For each Pacific Rim country involved in log trade, a supply curve or a demand curve (or both) was estimated, generally by econometric methods. Putting log trade and prices into a supply-demand framework has the advantage of dealing explicitly with the relationships between price and quantity. It also provides a common conceptual framework for dealing with the many diverse economies around the Pacific. The approach used in this study has not been applied previously to international forest products trade among several countries.

From historic data a demand equation, relating the volume of logs imported to their price and other factors that change over time, was developed for each consuming country. A typical equation related the volume of log imports to their unit value as they entered the country. A demand equation is plotted in figure 1, with values of all independent variables except price set to levels appropriate to 1983. Thus figure 1 shows the interaction of value and volume with all factors that could affect their relationship at 1983 levels.

Supply equations that relate the volume of logs exported to price and other factors were estimated individually, in a similar manner, for each sender country. The supply curve of figure 1 shows that in 1983 higher prices would have induced greater exports.

Demand calculations were made for China, Japan, Korea, and Taiwan. Supply estimates were developed for Canada, Chile, New Zealand, United States, and the Soviet Union.

Price and quantity data in the study are annual averages. Results should be interpreted similarly, with prices seen as averages of values that fluctuate seasonally, as do quantities. Calculations are done in local currencies and cubic meters.

Inflation has been great in several of the countries studied. For a comparable dimension prices were adjusted to 1983 "real" levels for each country before analyses were begun; generally, wholesale price indexes were used.

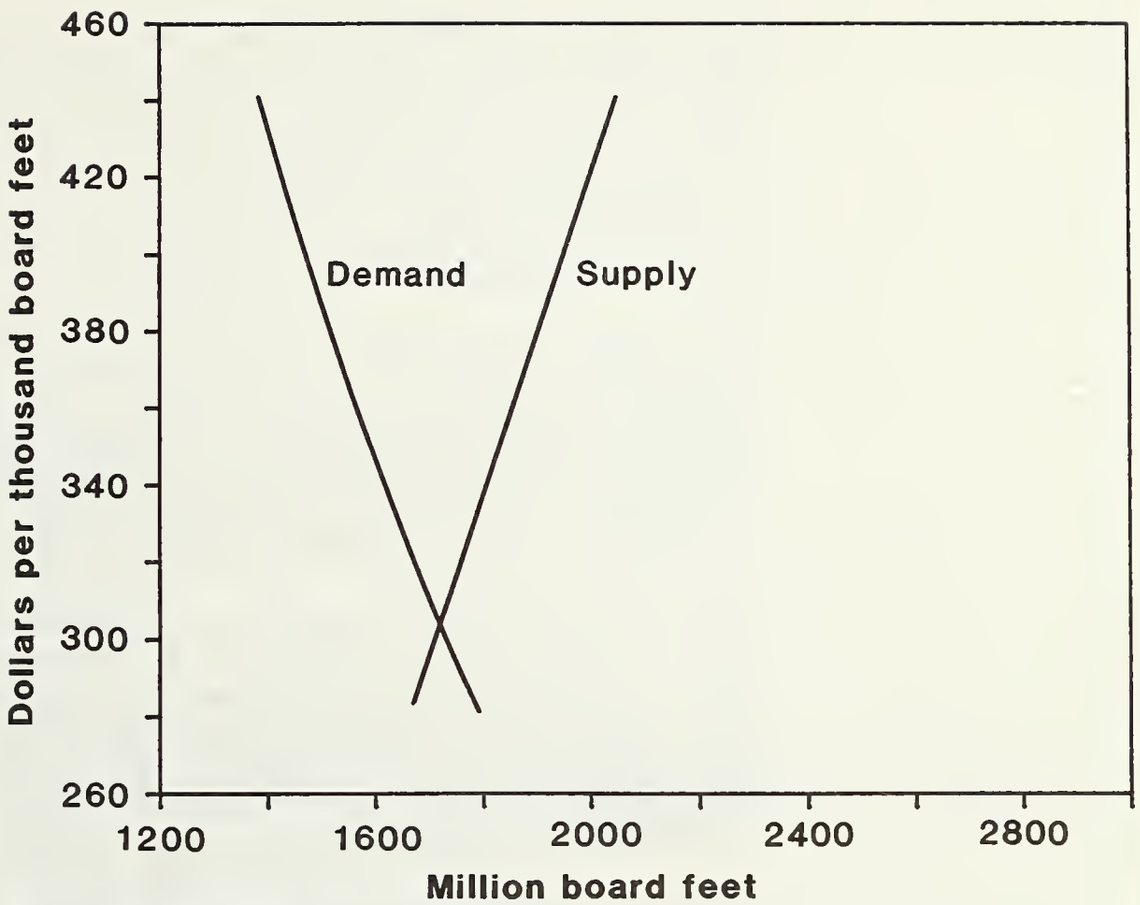

Figure 1.—Total Pacific Rim supply and demand for construction-grade logs, 1983.

Each supply and demand equation includes other variables that shift the curves with the passage of time. The most commonly used "shifter" is GNP (gross national product) in demand equations. Supply equations use timber production and domestic consumption. Shifting variables that lend themselves to forecasting and World Bank (1984) projections of GNP were used. Reports of national forestry agencies and consultants were used for timber yield and consumption figures, which were used in certain supply and demand equations.

After supply and demand equations were developed, they were summed to yield an aggregate supply function and an aggregate demand function for the Pacific Rim. For this step it was necessary to convert values to a common currency relevant to the United States. Demand and supply equations were converted to U.S. dollars from 1983 exchange rates.

Demand equations were further adjusted for freight charges from supply countries. This step was especially important because consuming countries are different distances from source nations. Thus the demand of each country, initially expressed in c.i.f. (cost, insurance, and freight) terms, was recast in f.a.s. (free alongside ship) values along the west coast.

A similar adjustment was made for supply relations. The initial equations pertained to exports f.a.s. at the sending country. To be compatible with c.i.f. demand functions at the receiving country, the f.a.s. supply prices must be raised to include shipping costs to the demand country. Next, to be compatible with the demand functions, which were adjusted downward to relate to dockside supply prices in the United States, the supply functions must also be adjusted downward. This double adjustment process, wherever it was appropriate, was consolidated into a single step and thereby brought competitors' prices to America's door.

With all the demand and supply functions in a U.S.-compatible price context, they were summed horizontally. At each of a number of price levels the quantities estimated for 1983 for the demand countries were added together and plotted, yielding the consolidated demand function of figure 1. Identically, supply relations were summed. Their amalgamation appears also in figure 1. The point of crossing, at about 1.75 billion board feet and $300/MBF (thousand board feet), coincides with the actual Pacific Rim market for construction-grade logs in 1983.

The triangular area below the intersection, between the supply and demand curves, is of special interest. At each price level in that zone, the horizontal distance between the two curves measures "excess demand." That is the additional volume of timber, beyond what was offered at those prices, that would have been absorbed by Pacific Rim markets. Had any supplier been able to provide logs at dockside at those prices, the presumption is that they would have been sold. The analysis shows that an opportunity existed for lower cost logs in that triangle.

Projections of demand and supply to 1990 and 1995 for each country were made by inserting in the equations values for GNP and other shifting variables appropriate to those years. As with 1983, demand and supply estimates were then summed, producing the Pacific Rim market supply and demand curves of figures 2 and 3.

Assumptions that are key to this set of projections and all other forecasts in the study are that the world economy will not experience either a sharp recovery nor significant recession within the coming decade, so that markets for products offered by export-dependent countries like Japan will continue to grow modestly. It is also assumed that interest rates will decline enough to encourage capital formation at its 1983 level but will not fall so low as to discourage saving at less than the 1983 rate. These assumptions are considered not very demanding and to have a high probability of achievement.

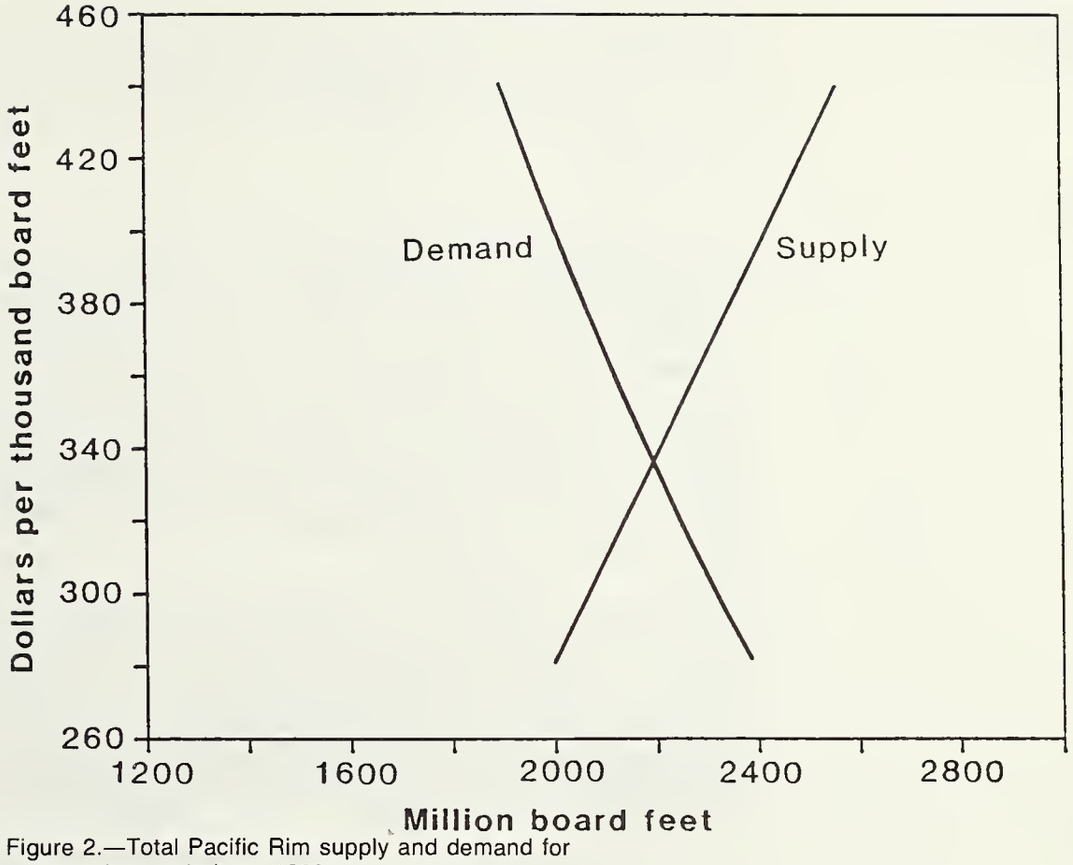

Figure 2.—Total Pacific Rim supply and demand for construction-grade logs, 1990.

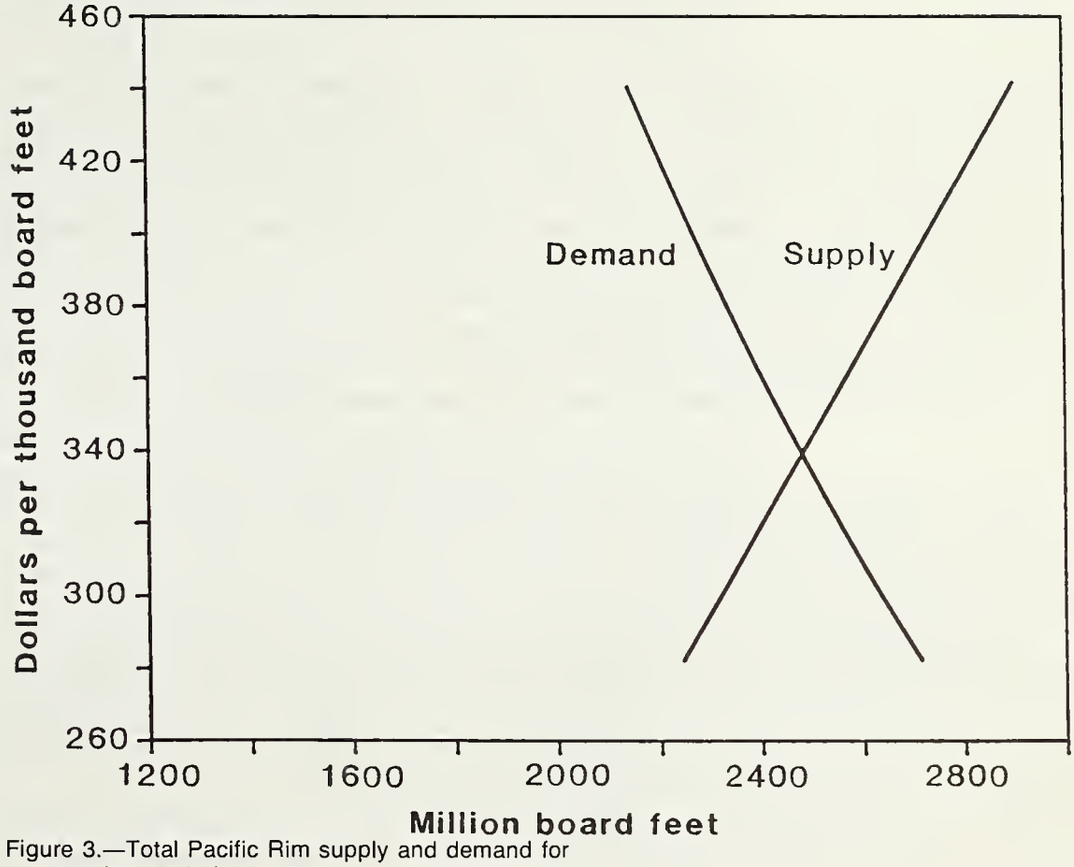

Figure 3.—Total Pacific Rim supply and demand for construction-grade logs, 1995.

The Country Studies

In this section are described demand and supply estimates for individual countries, combined into the composite demand and supply curves of figures 1 to 3. Here the underlying reasoning and assumptions are laid out, and the supply and demand curves for each country are shown. The supporting mathematics is described in the appendix.

Japan

Japan imports almost half the softwood construction-grade logs that move across the Pacific Ocean. Japan's proportional share of the market has declined, primarily because of China's entry. Starting in the early 1960's, Japan's roundwood imports climbed steadily through the 1970's. That growth reflected rising housing starts and an ever stronger economy (Darr and Lindell 1982). During the 1978-83 recession gross national product continued to grow but at a slower rate. From 1970 to 1978 the inflation-adjusted rate of GNP growth was about 5 percent; from 1979 to 1983 it was about 4 percent. Housing starts, having reached about 2 million in 1973, were about 1.5 million per year for the balance of the decade, dropping to about 1.1 million during the recession.

The affluence of Japan is well known. Gross national product per capita was about $10,000 in 1982, having risen an average rate of 6.1 percent per year since 1960 (World Bank 1984). Comparable figures for the United States are $13,000 and a 2.2-percent growth rate. Moderation of the Japan economy is seen in its inflation rate. Consumer prices are rising at about 2.5 percent per year, compared with about 11 percent during the growth and energy constraints of the 1970's.

Japan is highly dependent on imports. Imports, however, are equivalent to only about 12 percent of GNP, a rather small figure for an insular economy, and one that reflects emphasizing imports of raw materials rather than finished goods. United States imports are about 8 percent of GNP. For Japan, exports equal about 13 percent of GNP; for the United States, about 7 percent.

For Japan, softwood roundwood of all kinds, including pulpwood and appearance-grade as well as construction-grade logs, comprise about 2.5 percent of total imports (Katsuhisa 1984). Japanese interest in improved self-sufficiency in wood products is well known (see, for example, Japan Forestry Agency 1984). Log and lumber imports, including hardwoods, were about 20 billion board feet in 1982, whereas domestic log production has been fairly stable at about 7 billion board feet since 1977. Almost half the plantations in Japan are 16 to 35 years old, many ready for commercial thinnings. About 60 percent of the domestic forests are softwoods. Japanese economists (for example, Nomura 1984) believe that domestic supplies will not materially reduce their demand for construction-grade logs before 1995, mainly because cultural treatments have lagged and extraction costs are high.

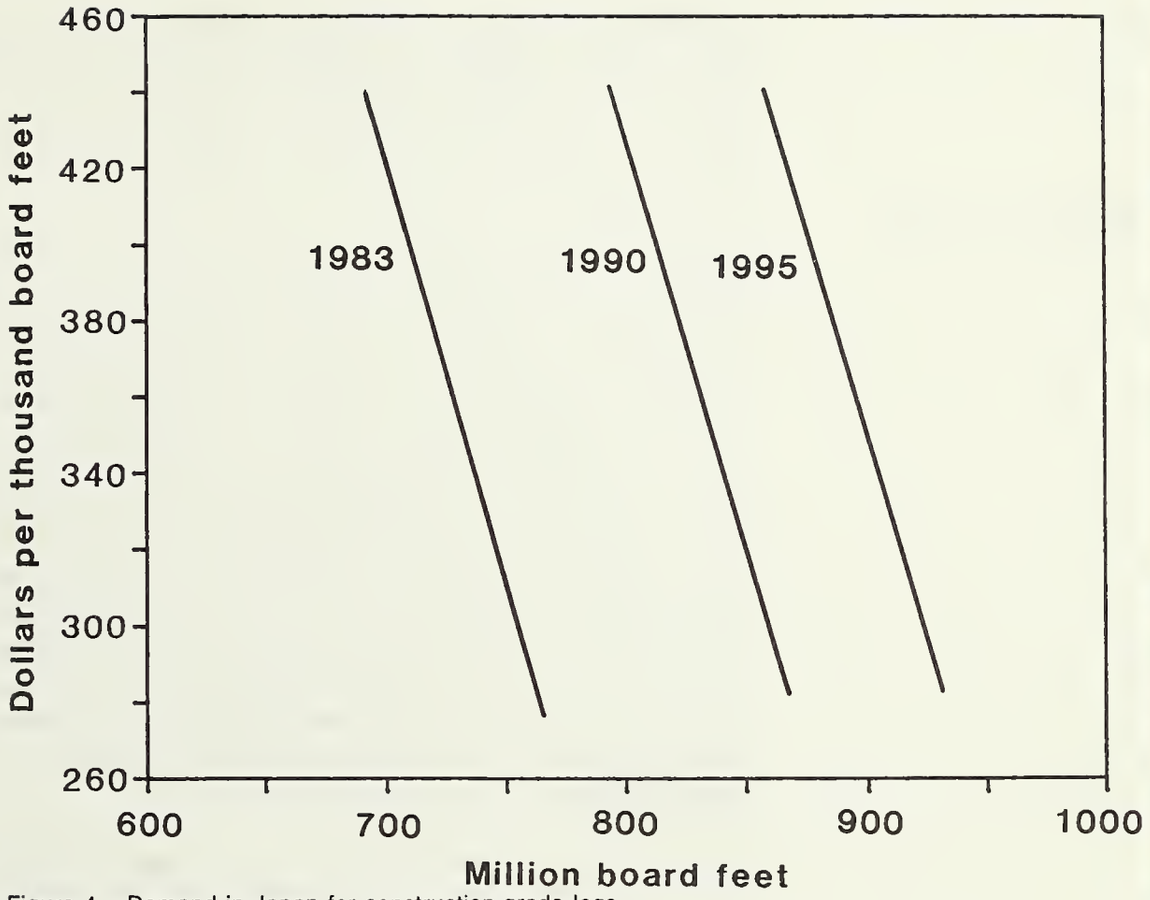

Figure 4.—Demand in Japan for construction-grade logs.

Because of Japanese emphasis on imports of appearance-grade logs, and because grades and sizes of logs are not separated in import statistics, for this study it was necessary to estimate the volume of construction-grade logs arriving in Japan from each supplier country. Proportions were based on a study on wood usage in 1981 (Japan Forestry Agency 1983). Overall, about 35 percent of the imported logs used for lumber become boards, boxes, packing, furniture, cabinets, and other products. This value does not depend on surface appearance nor on stress rating. Reported values of imported logs were similarly adjusted. The effect of this adjustment was to bring the 1983 c.i.f. value of imported construction-grade softwood logs to an average of $430/MBF. A considerable variation among sizes and species was recognized in the study.

Figure 4 portrays the estimated demand for construction-grade softwood logs in Japan, f.a.s. the U.S. west coast. The curves show the volume that would have been purchased at various prices in 1983, with projections to 1990 and 1995. The curves represent Japanese demand for wood from all sources, adjusted pricewise to include transportation and related costs. For example, a demand price of $430/MBF in Japan corresponds to a demand price in the United States of about $300/MBF.

The shift of the curves to the right over time was estimated on the basis of continued growth in GNP at an inflation-adjusted rate of at least 3 percent, which supports housing starts at rates adjusted from Ueda and Darr (1980). The estimates are 1.3 million residences in 1985, 1.4 million in 1990, and 1.3 million in 1995; the decline in the 1990's is attributable to demographic factors.

Republic of Korea

In 1982 Korea consumed about 18 percent of the construction-grade softwood logs traded in the Pacific Basin. Rapid economic growth spanning two decades suggests that Korea will be a steadily growing force in the timber trade. Population there is about 40 million, and gross national product per capita is about $1,800. The average annual growth rate per person for economic welfare has been about 7 percent, in real terms, since 1960. (For the United States the comparable figure is 2.3 percent.) With almost no natural resources, Korea has changed in 20 years "from a marginally subsistent agricultural economy into one of Asia's major industrial nations" (U.S. Department of Commerce, International Trade Administration 1983). The nation's commitment to economic growth is frequently stated, and its strong support of industry is clear. Materials demand from the industrial sector has contributed to the inflation rate in Korea, which increased about 20 percent from 1960 to 1980. Over the same period real GNP grew about 10 percent per year. The recession reduced the country's inflation rate and its GNP growth rate to about 3 percent per year. The Korea Development Institute (quoted in IBR, Inc. 1984), however, expects inflation to remain below 3 percent while the GNP growth rate rises to 8 percent, at least through 1985.

As in Japan, manufactured exports have been a primary driver of the economy in Korea. Korea is well known for its turnkey development of major industrial and energy facilities in other countries. These activities are supported by imports equivalent to about 37 percent of gross national product.

Korea has a significant external debt problem. In 1982 external public debt was equal to about 28 percent of GNP (World Bank 1984). On the other hand, gross domestic saving is equal to almost one-fourth of GNP.

Of its $24 billion of imports in 1982, about 0.5 percent was spent on softwood lumber and logs (World Bank 1984; United Nations, FAO 1984). To the Pacific Northwest, Korea is an important client for logs; "K-sort" is standard timber trade jargon for small logs meeting Korea's specifications. Korea's conifer log imports in 1983 were about 400 million board feet.

For a decade, Korean log imports have shown a strong relationship to their gross domestic product (GDP), an economic measure that is similar to gross national product. This relationship was used to shift the demand curve through time. Figure 5 shows estimated demand curves for Korea.

Two potential sources of change are not reflected in this study. One is Korea's program of reforestation, whose production so far has moved into pulpwood, mine timbers, and fuel wood. During the 1970's about 1 million hectares were planted in hardwoods and softwoods. In 1984 the Korean Office of Forestry began a policy of restraining the harvest of pine trees to stands older than 50 years, with similar age limits on other species. This regulation, considering the age structure of Korea forests, appears to postpone any increase in domestic harvest.

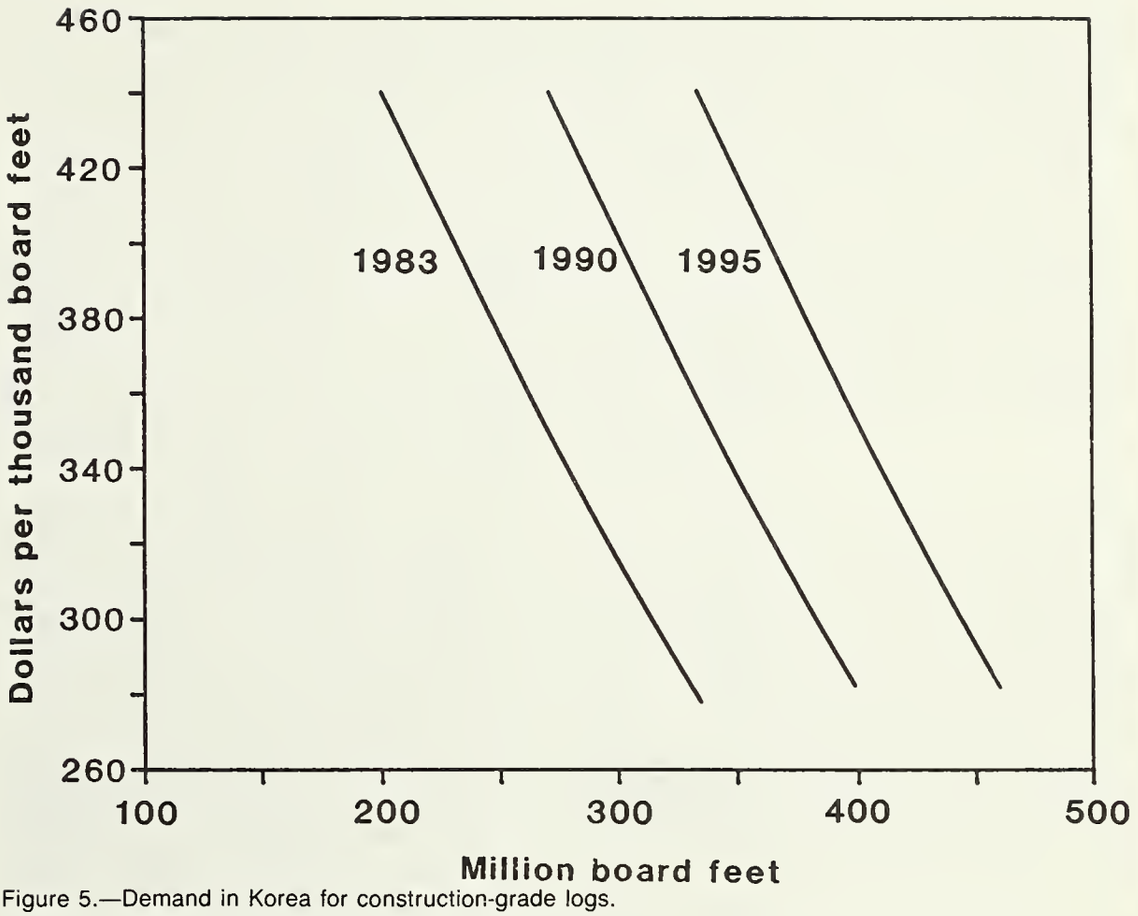

Figure 5.—Demand in Korea for construction-grade logs.

The second element of uncertainty pertains to the 5-year plan that increases emphasis on social development, including housing. The plan, effective in 1982, calls for tripling the rate of home construction from about 100,000 to about 300,000 units per year. The effect on wood use may be small, however, because less than 2 percent of homes are built from wood; most are masonry.

Taiwan (Republic of China)

Taiwan, with a population less than half that of Korea, has a GNP that is about 70 percent of Korea's. Per capita income is about $2,600 (U.S. dollars), about 45 percent higher than Korea's. Industrial development in Taiwan has followed a similar path, with growth rates of about 10 percent per year in GNP from 1960 to 1980 (U.S. Department of Commerce, International Trade Administration 1983). During the recession the growth rate dropped to about 4 percent (Economic Daily News 1984). The real growth rate of GNP is expected to have returned to 6 percent in 1984 (World Bank 1985).

With limited natural resources, Taiwan is attentive to foreign trade. Exports account for about half of the GNP. Wood products, primarily hardwood plywood, are associated with 6 percent of Taiwan's exports and about 4 percent of its manufacturing workers (BIS Marketing Research Limited 1982). Until 1981 Taiwan was the world's largest plywood exporter. First place has lately been taken by Indonesia (U.S. Department of Agriculture, Foreign Agricultural Service 1983b). Taiwan has relied for at least two decades on hardwood logs from Asia to produce (for export) veneers, hardwood plywood, and "value-added" plywoods such as overlays and hard finishes.

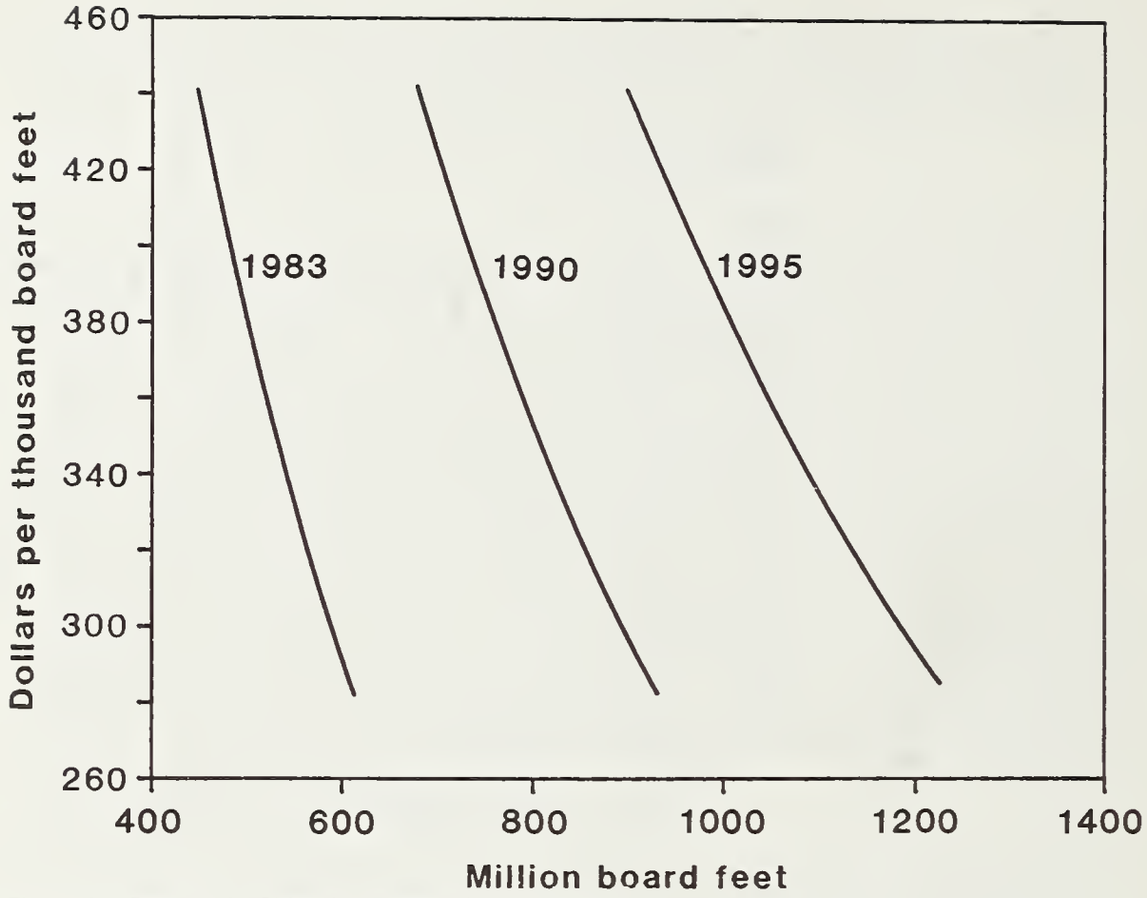

Figure 6.—Demand in China for construction-grade logs.

For its domestic construction needs, Taiwan has relied on its own forests. About half the country is in timber, of which about one-fifth is conifers. Harvests have declined steadily since about 1970, however (Taiwan government statistics cited in U.S. Department of Agriculture, Foreign Agricultural Service 1983b). Conifer log production has dropped by almost half since 1971 along a steady linear trend (Jen 1982, 1984). In the same period housing starts increased sixfold, pressing softwood prices upward. Adjusted for inflation, log prices doubled in a decade.

Taiwan softwood imports have been limited to pulp chips and pulp almost exclusively. Pacific Rim softwood demand projections seem to require, however, that provision be made for potential demand for construction wood as domestic softwood supplies decline. To this end demand curves were estimated for softwood consumption from all sources, and supply curves for domestic softwood log production. Net demand is shown in figure 6. The negative portion of the horizontal axis indicates that in 1983 Taiwan would have been a net supplier at high prices. The shift of demand over time was based on its relationship with GNP. Supply is assumed to shift along its linear track at the rate experienced in the 1970's.

People's Republic of China

With perhaps 2 million cottage industries, a vast rural area, and the prevalence of barter and exchange of services that small farming implies, the published estimates that put GNP per capita in China between $300 and $400 are undoubtedly inadequate estimates of economic welfare. The economic significance of foreign trade to China is similarly hard to gauge because of an administered floating exchange rate, administered domestic prices that mask inflation, and an internal pricing structure that restrains imports, subsidizes investment with a zero-percent interest rate, and keeps certain urban consumer prices (including rent and grain) relatively low (Lardy 1983; U.S. Department of Commerce, International Trade Administration 1983). Creation of free enterprise zones and the 1984 plan to loosen the economy will have as-yet-unpredicted effects on economic activity. Finally, the short recent history of active economic development makes econometric demand estimates, based on historical evidence, impossible.

Since 1977 China's trade has doubled every 3 years. Although China has lately enjoyed a foreign exchange surplus it is less than $25 billion, and total exports in 1984 were about $43 billion. Although this activity is trivial relative to that in the United States, China's exports are equivalent to more than 10 percent of published GNP. This compares with about 20 percent in the United States and is considered remarkable in the context of China's history of economic independence. For economic development and trade expansion, China is dependent on a mixture of foreign investment and borrowing from banks, foreign countries, and world organizations. Clearly pursuing these various avenues cautiously, China must meanwhile ration its foreign exchange among the many raw materials and capital goods in which the country has shown interest.

It is assumed for this study that China will allocate a constant fraction of its spending on imports to softwood logs. In 1983 this was about 1.3 percent. It follows from this assumption that at higher prices the Chinese will purchase less timber (fig. 7).

It is also assumed that imports will remain at about 9 percent of national income. World Bank (1984) projections were used to support an estimate that the national income in China will rise 8 percent per year through 1985 and 6 percent per year thereafter.

China is estimated to have imported about two-thirds of a billion board feet of construction-grade logs in 1983. The comparable estimate for Japan is about 1 billion board feet. These volumes represent for China about 75 percent of all log imports, whereas for Japan construction-grades are estimated to constitute about 35 percent of log imports.

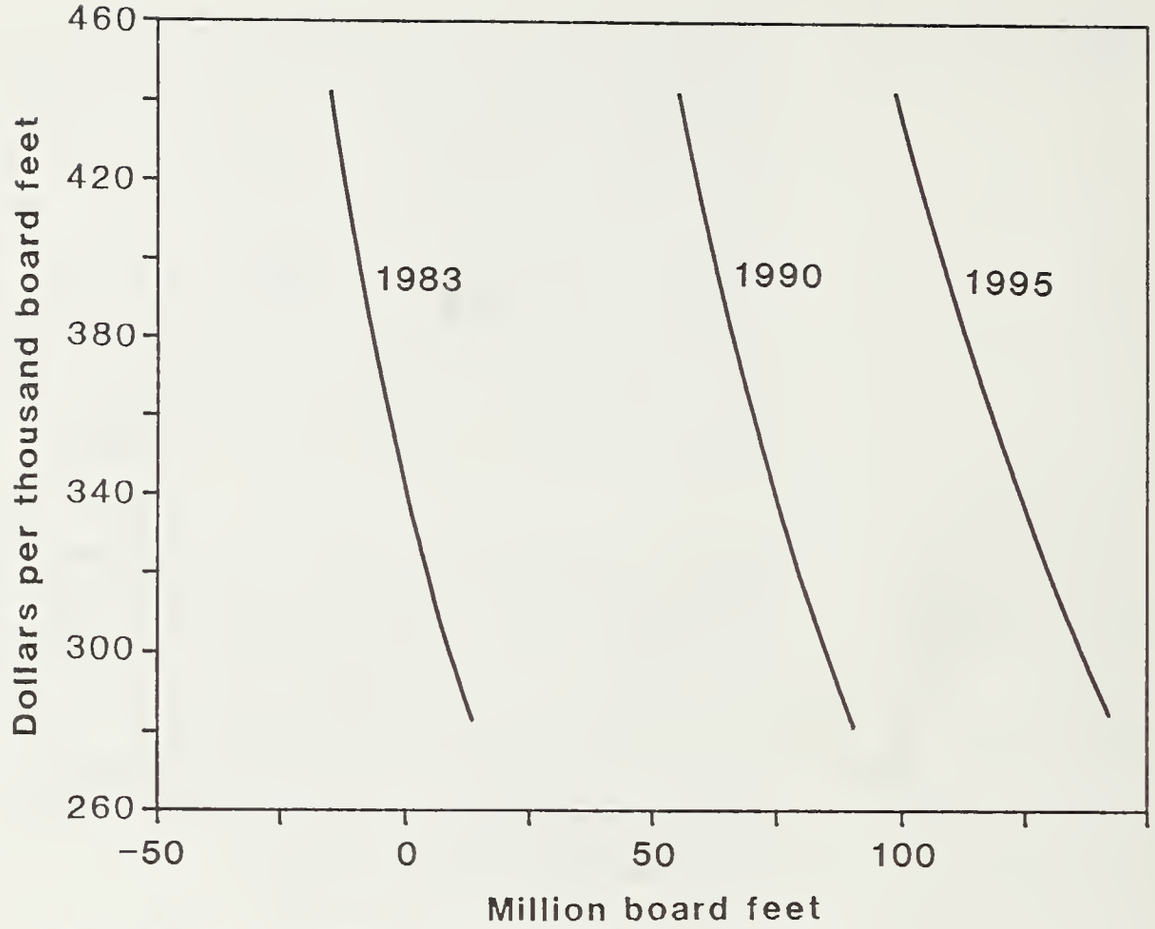

Figure 7.—Net demand in Taiwan for construction-grade logs. Negative quantities represent exports from Taiwan to non-Taiwan countries; positive quantities represent imports to Taiwan.

Supply Estimates

United States

Log export data for the United States from 1963 on was used to estimate the shape of the supply curve for construction logs (fig. 8). In 1983 U.S. exports of construction-grade softwood logs were about 425 million board feet, about 15 percent of all log exports. Their average dockside value was about $290/MBF.

Shifts in the supply curve over time are keyed partly to harvest volumes in the Douglas-fir region as projected by Haynes and Adams (n.d.) for a national report on timber supplies (USDA Foreign Agricultural Service 1984). The regional harvest estimates integrate economic supply and demand forces that arise from the several U.S. supply and demand regions and impinge on log supplies available for export. Figure 8, therefore, indicates declining sales from the United States.

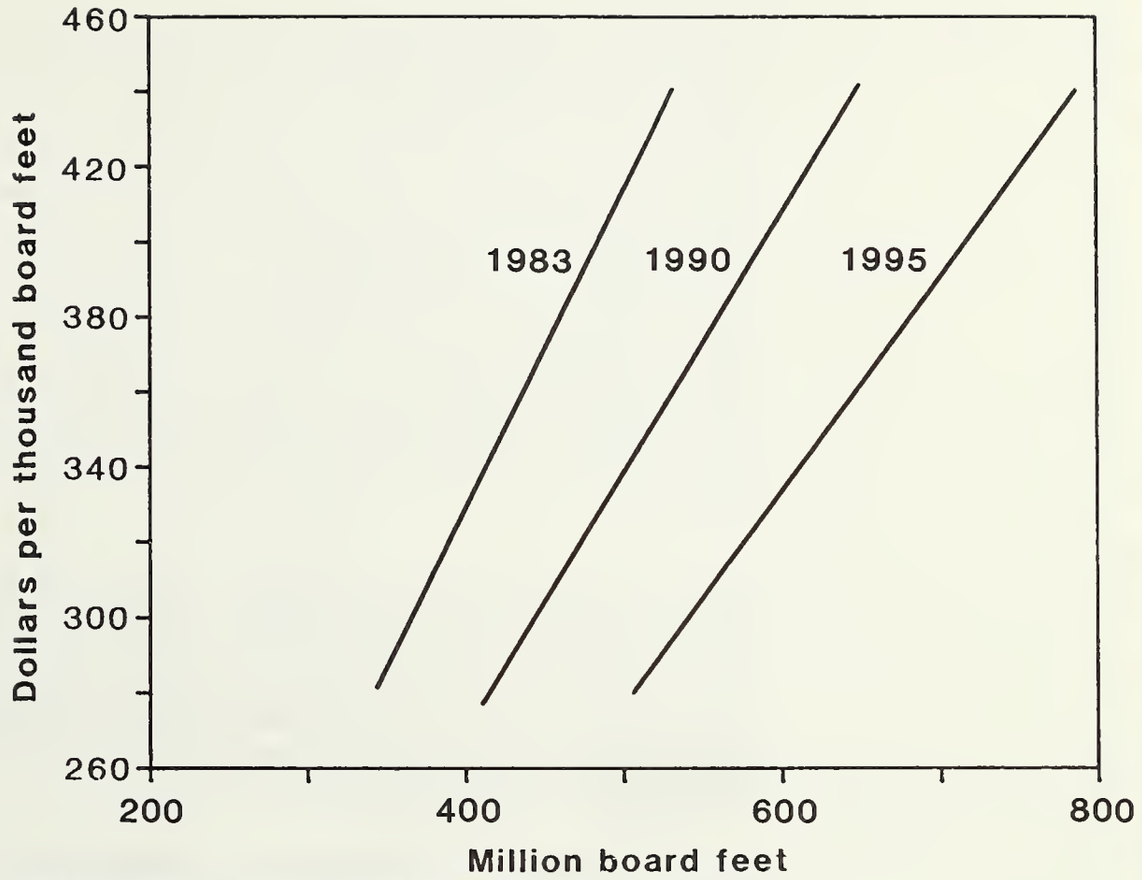

Figure 8.—Supply of construction-grade logs exported from the United States.

Soviet Union

As with China, an administered nonconvertible currency creates difficulty in gauging the scale of economic activity in the U.S.S.R. For several reasons, the Soviet measure of "net material product" is not comparable with the same measure for other countries (The Economist Intelligence Unit 1984c). A comparison of these measures over time, however, suggests that during the 1978-83 recession the Soviet economy grew between 3 and 4 percent per year in real terms, with a rate of 3 percent estimated for 1984.[1/]

Trade circumstances in the U.S.S.R. are more clear, although many Soviet transactions with eastern bloc countries are not at prevailing world prices (The Economist Intelligence Unit 1984c). In 1982 their exports were about $120 billion; in that year U.S. exports were about $210 billion. Oil and natural gas account for three-fourths of the U.S.S.R. export earnings from the West, a degree of dependence that has contributed to their trade deficit. During the 1980's period of low oil and gas prices the U.S.S.R. is increasing its oil exports. Conversely, the U.S.S.R. has benefited considerably from oil sales during strong portions of world economic cycles. There presently (1985) exists no agreement among analysts about whether Soviet oil exports can continue at their early 1980's level. A moderate upward trend in petroleum exports to the West apparently has been at the expense of sales to eastern Europe and domestic consumption (The Economist Intelligence Unit 1983). In any case, Soviet commitment to exports of oil, gas, and coal is clear.

[1/]International Monetary Fund. International financial statistics. Data tapes on file, DATABNK. Seattle, WA: University of Washington; 1984.

Only about 4 percent of Soviet log production, including hardwoods, is exported; however, this material generates about 3 percent of U.S.S.R. export earnings (USDA Foreign Agricultural Service 1984). That level is comparable to the role of timber in U.S. exports. There is an increasing emphasis on timber harvests in Siberia and the Far East, which now account for more than 40 percent of the Soviet timber production. The eastward shift has occurred primarily because of past heavy inroads on the timber resource of European Russia. Exports from eastern U.S.S.R. are important not only to that country but also to Pacific Basin wood products trade. Logs appear to constitute virtually all of this flow, a circumstance that will change as pulping and sawing plants are established along the route of the new Baikal-Amur railroad from southern Siberia to the sea (United Nations, Economic Commission for Europe and FAO 1980). Logs exported from eastern U.S.S.R. constitute almost 60 percent of the construction-grade logs sold by Pacific Rim countries. This figure includes shipments by rail from U.S.S.R. to China.

The Soviet timber industry, operating in a centrally planned economy, is provided with 1- and 5-year plans (Blandon 1983). The system, involving quantity targets and goals, expresses itself in log sales to the Pacific Rim countries. Five-year and one-year contracts that establish timber volumes are negotiated with customers. Prices are negotiated later on an annual and quarterly basis (Ogawa 1984). The current 5-year contract with Japan, which ends in 1985, covers about half the logs being purchased by Japan from U.S.S.R.

The quantity-first-price-later approach to marketing was mirrored in this study. It was assumed that quantities of logs moved from U.S.S.R. across the Pacific would not be influenced by prevailing prices, at least during the coming decade. The resulting set of supply curves is shown in figure 9. Shifts over time were based on the current 5-year plan and on an FAO projection (USDA Foreign Agricultural Service 1983c; United Nations, FAO 1982).

New Zealand

Wool, meat, and dairy products have been the mainstays of New Zealand exports for many years. They account for more than half the exports; forest products constitute 7 percent. Demand for primary commodities has been relatively flat during the 1975-85 decade. Productivity growth in other sectors has been low. These factors have combined to hold New Zealand per capita GNP almost constant at about $7,700; lower than that of Japan ($10,100) and Canada ($11,400) but substantially larger than most other Pacific Rim countries.[2/]

After removal of native forests New Zealand undertook a major program of reforestation with radiata pine. A program of short-rotation forestry, including thinnings and pruning, extended from the late 1920's through the 1930's and resumed in the 1960's. The timing of future yields from these stands has been estimated in detail. A surge in harvests is expected in the latter half of the 1990's and is expected to continue indefinitely. New Zealand is looking toward these forests as an important source of foreign exchange, with export earnings as high as $500 million per year (1980 prices) by the turn of the century (New Zealand Forest Service 1980). If the rest of the country's economy remains constant, wood products will then comprise more than 14 percent of New Zealand exports.

[2/] Prices and income figures are in 1983 U.S. dollars unless indicated otherwise.

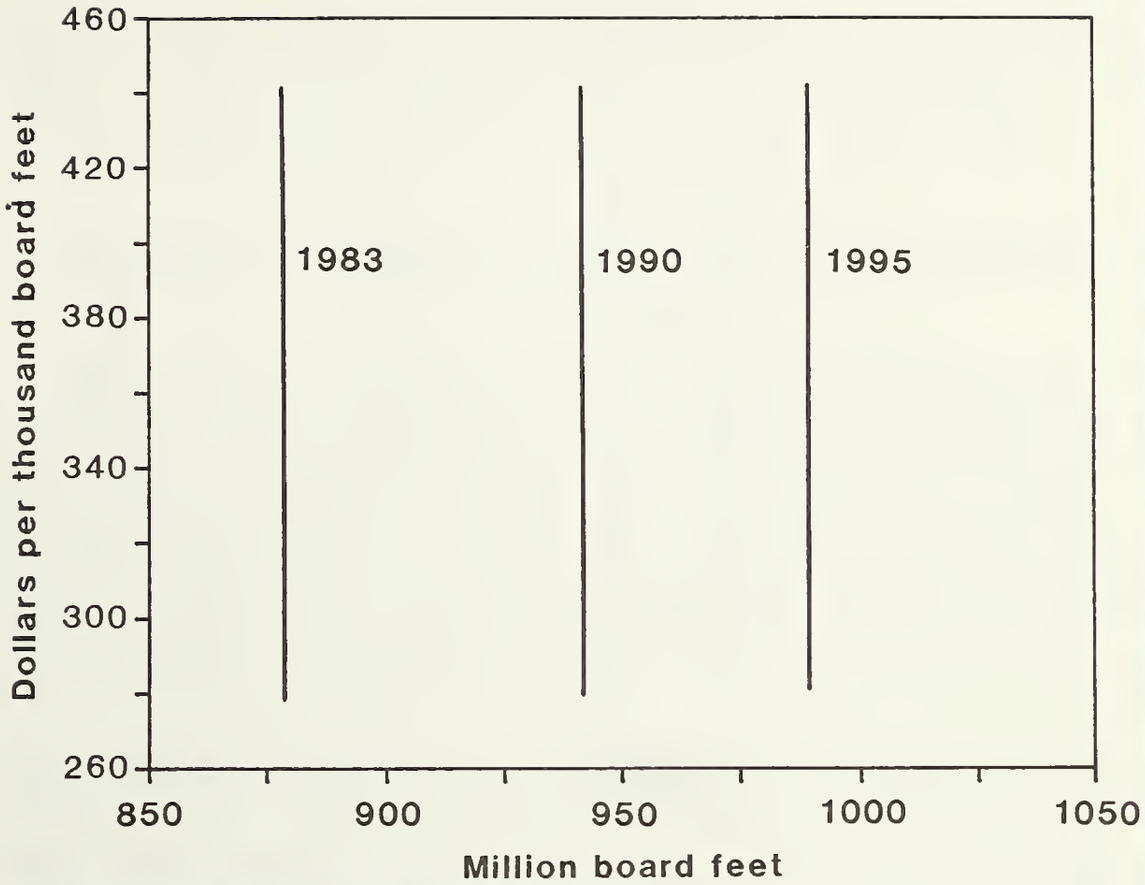

Figure 9.—Supply of construction-grade logs exported from U.S.S.R. Vertical lines indicate that quantities would not be affected by prices.

Log exports are already important. In 1980 overseas sales of logs and poles generated more than $60 million (f.o.b.—free on board) (New Zealand Forest Service 1984). In 1983 the comparable figure was about $40 million; the difference was due to reductions in volume, price, and the value of the New Zealand dollar.

New Zealand contributes about 6 percent of the construction-grade softwood logs that move among the Pacific Rim countries. Their cost seems low by U.S. standards, reflecting the relative values of the two currencies and quality considerations. Older stands, presently being cut, were mainly unpruned and therefore yield a much smaller fraction of clear woods than is expected in the future. There are concerns about strength, related to the rapid growth of radiata pine. In Japan, a major market, at least 70 percent of this species is used for boxes, crates, and packing materials (Japan Forestry Agency 1983).

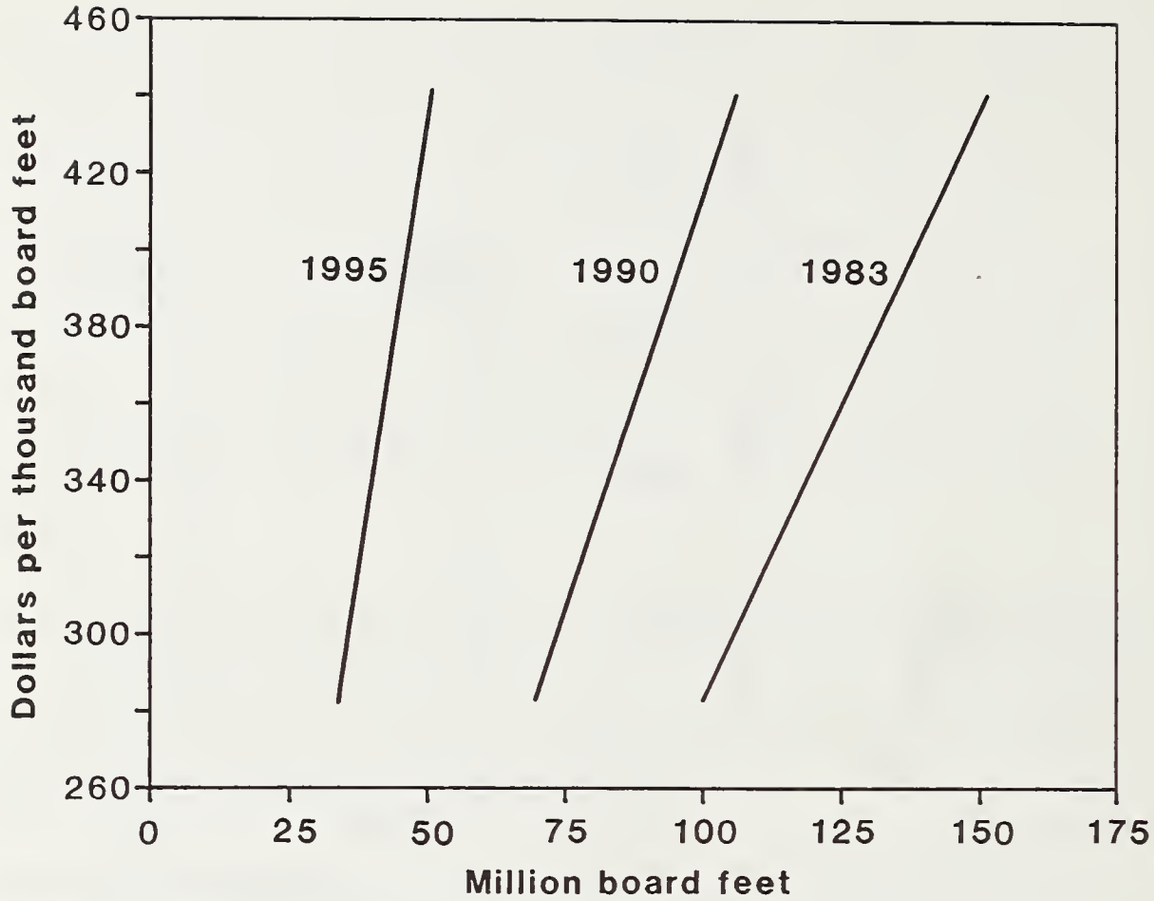

Figure 10.—Supply of construction-grade logs exported from New Zealand. Quantities exported are expected to decline through 1995.

Figure 10 shows the supply estimates made for New Zealand. Exports of construction-grade logs are expected to decline over the next decade, almost regardless of Pacific Rim log prices. There are two reasons. Steadily growing GNP will draw domestic timber into domestic uses; a World Bank (1984) projection of real gross domestic product growth at 2.5 percent per year was adopted. The second, and most significant, reason is that New Zealand's strategic planning and marketing efforts will increase acceptance of radiata pine for structural uses, moving 25 percent of the material here classed as "construction-grade" into higher value uses by 1990 and 50 percent by 1995. The result is greater roundwood export earnings despite a volume shrinkage in the log category studied here.

Not shown is the surge of supply that appears inevitable after 1995. New Zealand has 10 years to promote demand for the new generation of radiata pine products and to make decisions about the relative merits of pulp, plywood, lumber, and log exports.

Chile

During the early 1980's the economy of Chile was troubled by low recession-related copper prices and inflation greater than 20 percent. The country's difficulties in repaying foreign loans led to significant austerity programs. Gross domestic product per person in 1983 was about $1,700. On the other hand, currency devaluation generated a positive trade balance, and exports are almost 15 percent of GDP.

Despite weak world markets for wood-based commodities, forest products were the third most important source of foreign exchange in Chile in 1983; they accounted for about 8 percent of exports (The Economist Intelligence Unit 1984a).

In 1983 logs constituted only about 10 percent of forest products exports (The Economist Intelligence Unit 1984b). The logs were virtually all radiata pine; most went to Korea, Japan, and China (USDA Foreign Agricultural Service 1983a). Like New Zealand, Chile looks toward radiata pine as a major producer of foreign exchange later in the century. The government hopes to increase export earnings from wood products by sixfold in the late 1990's (The Economist Intelligence Unit 1984b). Chile plans harvest at earlier timber ages than does New Zealand and with relatively little thinning or pruning. The area of plantations created each year has more than doubled since 1974 (Chile Instituto Forestal and Corporacion Nacionel Forestal 1984a).

The projected supply curves for Chile are shown in figure 11. Estimates of the increase in supply in the 1990's range from doubling (USDA Foreign Agricultural Service 1983a) to quadrupling (Husch 1982). These estimates, however, relate to harvests; the increase in log exports was assumed to be at the upper end of this range because of delays in Chile's ability to gain the foreign investment needed for infrastructure and wood products manufacturing capacity. In 1990, 10 percent of log exports from Chile were assumed to be accepted into structural uses; this figure was increased to only 12 percent in 1995 because of relatively short rotations and the recent interruption of intensive forest culture.

Canada

British Columbia's prohibition of log exports from Crown lands limited Canadian offshore log exports to less than 100 million board feet per year (Council of Forest Industries of British Columbia 1985) through 1978. During the recession, exemptions granted on an individual-lot basis, generated by poor domestic markets, raised offshore exports from the west coast of Canada more than fivefold between 1978 and 1984, an average increase of 33 percent per year.

New export rules, currently being elaborated, provide for predesignation of stands and large tracts that contain timber economically unattractive to domestic markets. By permitting a longer term assessment of supplies available to export, trading firms will gain several advantages. Buyers will be able to judge handling and transport needs and to arrange resale in an orderly manner in their countries. Timber operators and sellers can gear themselves to stable expectations.

In the short run, foreknowledge should make f.a.s. log supplies more elastic because of increased flexibility in the timing of overseas shipment. Depending on rules yet unwritten, sales during periods of rising prices could possibly be delayed. In the longer term, the effect of predesignation on price responsiveness will depend on whether designations will be withdrawn in response to higher domestic prices, what the tenure of designations will be, and how quickly designations can be established during declines in the domestic market.

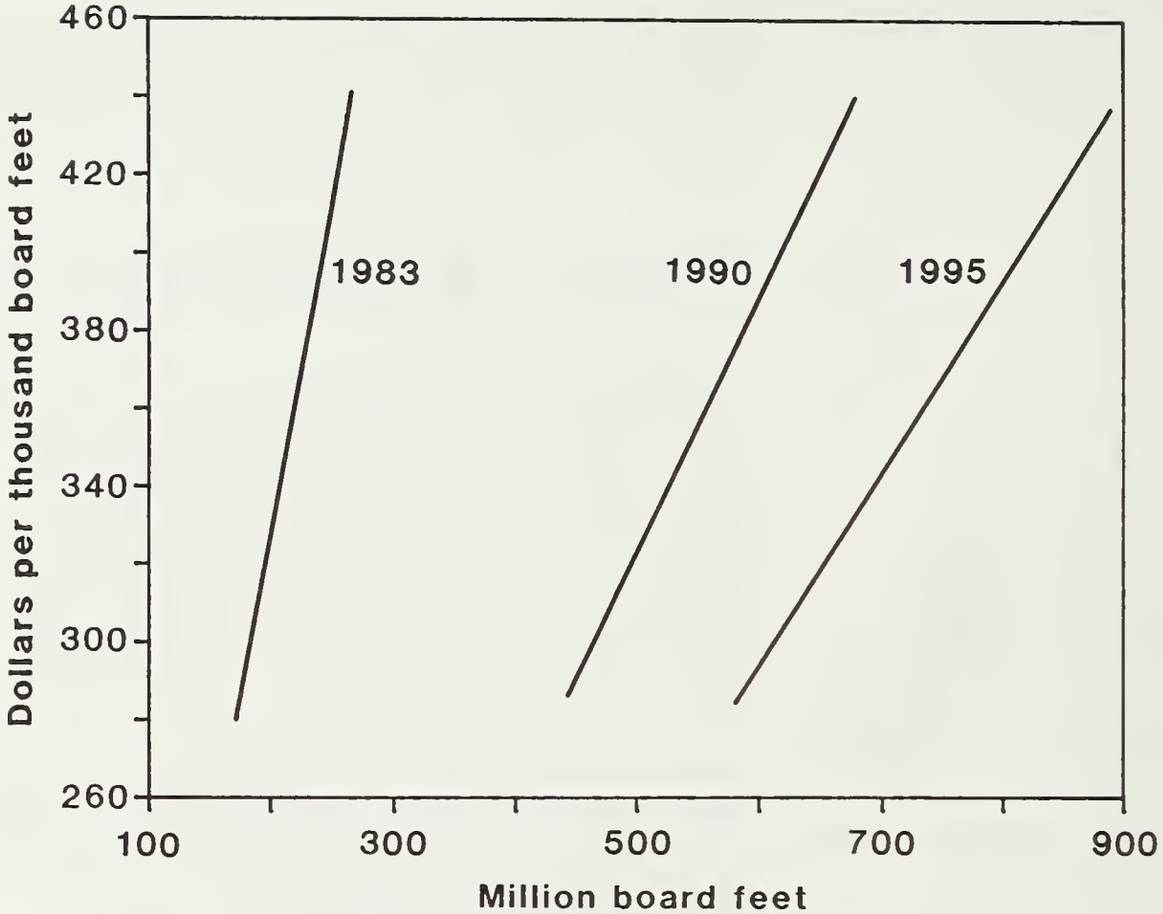

Figure 11.—Supply of construction-grade logs exported from Chile.

Because an increase was expected in short-term elasticity, a price elasticity estimate was drawn from Canadian lumber exports to the offshore Pacific Rim. The estimate, 0.57, is roughly midway between the absolute inelasticity implied by quantity controls and the elasticity estimated for U.S. log exports, 1.0. Figure 12 portrays the resulting supply curves. It was assumed that the upward trend in Canadian log exports will stabilize, and that of this volume about 130 million board feet of construction-grade logs will be exported to countries outside North America.

Substantially different conclusions can be drawn about the volume of construction-grade logs that will be permitted to leave British Columbia and the volume that can be recovered economically from predesignated stands.[3/] The volume assumptions of this study are considered to be near the lower end of the speculative spectrum.

[3/] Flora, Donald F.; Vlosky, Richard P. An equilibrium model of Pacific Rim trade in small logs. 1985. Manuscript on file. Seattle, WA: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

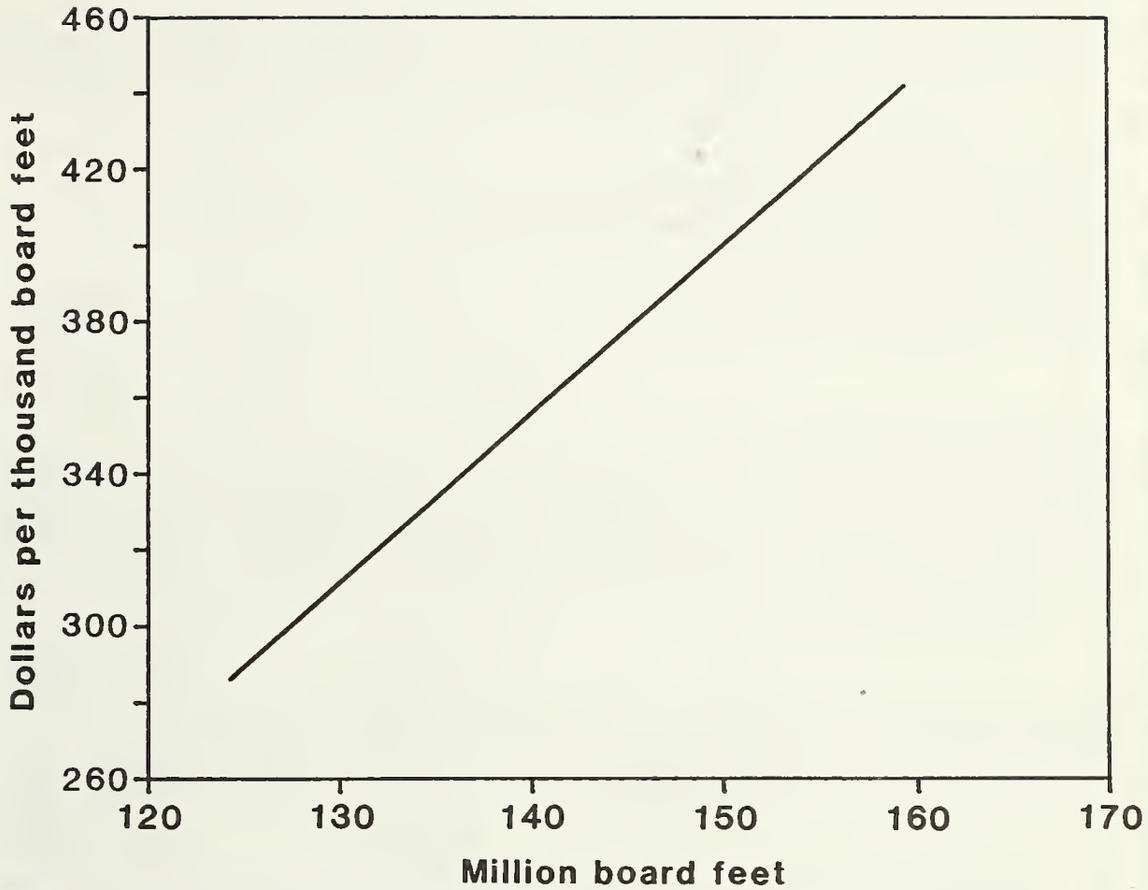

Figure 12.—Supply of construction-grade logs exported from Canada. The relationship of prices to quantities is projected to be constant through 1995.

Results

The aggregate Pacific Rim supply curve crosses the aggregate demand curve at $300/MBF for 1983 in figure 1. Considering that the aggregate curves were summed from several individual curves, most of which were fit stochastically and therefore have no precise locus, the intersection is satisfactorily close to the estimated volume-weighted export price of $290 in 1983. The "precision" of the aggregate volume estimate for 1983, 1.72 billion board feet log scale, is hard to check because construction-grade has no specific counterpart among grades used in the log trade.

Volume changes over time are estimated to be substantial. Exports (and imports) of construction-grade logs are estimated to expand 14 percent between 1983 and 1990, and 14 percent more in the next 5 years, indicated by the intersections in figure 2 and in figure 3. Total trade in this kind of logs is estimated to be about 2.2 billion board feet in 1990 and about 2.5 billion board feet in 1995.

Price changes are expected to be less substantial. Between 1983 and 1990 f.a.s. log prices are projected to increase 11 percent in real (inflation-adjusted) terms. Prices should be virtually constant during the early 1990's. In a preliminary analysis prices dropped almost 20 percent during the 1990-95 period, the result of an estimated price upsurge of almost 40 percent between 1983 and 1990. This estimated price gain disappeared with new, lower estimates of overseas demand and new, higher supply estimates for the 1990 supply for Chile.

Total spending on construction-grade logs (and total receipts for such logs) is projected to expand 41 percent between 1983 and 1990, and another 14 percent between 1990 and 1995. With increasing prices, even exporting countries that do not expand exports will experience rising log incomes.

Interval estimates of supply and demand elasticities in the aggregate construction-grade log markets are:

	1983	1990	1995
Supply	0.42	0.53	0.57
Demand	-.50	-.50	-.52

Construction-grade log exports and imports for individual countries are determined by using the Rim-wide equilibrium prices in each nation's equation, or by tracking the price graphically across the country's supply or demand curve. Estimated log flows are:

Country	1983	1990	1995
	(Million board feet)		
Imports:			
Japan	747	900	835
China	570	816	1,024
Korea	306	348	434
Taiwan	7	75	122
Exports:			
U.S.S.R.	877	940	988
United States	361	488	602
Canada	128	136	136
Chile	177	510	683
New Zealand	103	79	37

Conclusions

The Pacific Rim market for construction-grade logs is projected to expand significantly through 1995, with demand outpacing supply until 1990. For the subsequent half-decade, supply and demand should shift in concert. Effects on prices and log flows have been described earlier.

Total spending in 1983 dollars on this class of logs is expected to increase 70 percent during the 10 years; volume will increase 50 percent. The increase in prices will be an encouragement to intensive forestry, to development of small-log handling facilities, and to milling capacity geared to small material; the increased income will help facilitate these advances. On the other hand, the higher prices will tend to induce a search for substitutes even as they press users toward greater efficiency.

In the United States exporters of small logs are estimated to gain 3 percent (from 22 percent to 25 percent) in their share of the market. The higher prices and volumes, though, should increase payments to U.S. exporters about 90 percent. Export volume from the United States is projected to increase two-thirds for construction-grade logs.

Competitor countries are estimated to increase their export volume about 45 percent overall. Chile will generate the largest proportional gain (nearly fourfold is expected), as well as the largest absolute volume gain, about 0.5 billion board feet.

Among the consuming countries, China's imports are estimated to double by 1995, with a gain of 0.5 billion board feet. Japan's import growth is expected to be less vigorous, but quite significant, with a 12-percent gain attributable to a 90-million-board-foot increase. The absolute gains of Korea and Taiwan are projected to be comparable, at 130 million and 115 million board feet, respectively. For Korea this would be 42-percent growth; for Taiwan it would be a near-infinite change percentagewise because of negligible 1983 purchases.

For the importing countries, the implications for industrial structure and port facilities vary greatly. For Japan the increase would probably be treated as business as usual because the percentage change is not large and because construction-grade logs constitute only about one-third of their log imports. In Korea and Taiwan the effect on port activity may not be significant because of an offsetting decline in hardwood log imports. China, though, is already moving to expand coastal log-handling capabilities.

The rationale for Japan applies also to U.S. coastal facilities because this log class is only about 15 percent of all log exports. For Chile, though, quadrupling of roundwood sales would have important consequences for waterside transport and employment.

With elasticities of about 0.5, both exports and imports are price-sensitive at the aggregate, Pacific-Rim level. Conversely, a significant shift in supply or demand caused, say, by a change in international trade policies or a general rise in freight rates, should have appreciable effects on log prices.

Conversion Factors

Because the average size of construction-grade logs varies among countries, the relationship of board-foot volume to cubic meters varies also. Figures 4 through 12, and their companion equations, can be converted to dollars per cubic meter and thousand cubic meters as follows:

	Dollars per MBF to dollars per cubic meter, multiply by:	Million board feet to thousand cubic meters, multiply by:
Japan	0.18	0.0055
Korea	0.17	0.0060
China	0.17	0.0060
Taiwan	0.18	0.0055
United States	0.18	0.0055
Soviet Union	0.17	0.0060
New Zealand	0.18	0.0055
Chile	0.18	0.0055
Canada	0.22	0.0045

Conversion factors for figures 1 through 3 vary slightly within each figure, depending on the changing relative quantities associated with each country, as total Pacific Rim quantities change along the graphs. Reasonable approximations are 0.18 and 0.0055.

Literature Cited

BIS Marketing Research Limited. Pacific Rim markets for lumber and panel products, Korea. London; **1982.**

Blandon, Peter. Soviet forest industries. Boulder, CO: Westview Press; **1983.** 290 p.

Chile Instituto Forestal and Corporacion Nacionel Forestal. Forestry statistics 1983. Santiago; **1984a.** 83 p. [In Spanish].

Chile Instituto Forestal. Disponibilidad futura de madera en pie de pino radiata. Santiago; **1984b.** 141 p. [In Spanish].

Council of Forest Industries of British Columbia. British Columbia forest industry statistical tables. Vancouver, BC; **1985.** 6 p.

Darr, David R.; Lindell, Gary R. International trade in forest products. Chapter 4. In: An analysis of the timber situation in the United States, 1952-2030. For. Resour. Rep. 23. Washington, DC: U.S. Department of Agriculture; **1982:** 73-103.

Economic Daily News. Economic yearbook of the Republic of China. Taipei: Linking Publishing Co.; **1984.** 1,185 p. [In Chinese].

The Economist Intelligence Unit. World outlook 1984. London: The Economist Publications Ltd.; **1983.** 81 p.

The Economist Intelligence Unit. Quarterly economic review of Chile, annual supplement 1984. London: The Economist Publications Ltd.; **1984a.** 32 p.

The Economist Intelligence Unit. Quarterly economic review of Chile. No. 3, 1984. London: The Economist Publications Ltd.; **1984b.** 21 p.

The Economist Intelligence Unit. Quarterly economic review of U.S.S.R., annual supplement 1984. London: The Economist Publications Ltd.; **1984c.** 18 p.

The Economist Intelligence Unit. Quarterly economic review of U.S.S.R. No. 2, 1984. London: The Economist Publications Ltd.; **1984d.** 23 p.

Haynes, Richard W.; Adams, Darius M. Simulations of the effects of alternative assumptions on demand-supply determinants on the timber situation in the United States. A supporting technical analysis to America's renewable resources: a supplement to the 1979 assessment of the forest and range land situation in the United States. Washington, DC: U.S. Department of Agriculture, Forest Service; **n.d.** 113 p.

Husch, B. Forestry in Chile. Journal of Forestry. 80(11): 735-737; **1982.**

IBR, Inc. International business cycle developments. [Place of publication unknown]; **1984** (June): 79.

Japan Forestry Agency. Wood demand and supply in Japan. Tokyo: Nippon Mokuzai Bichiku Kiko; **1983.** 53 p.

Japan Forestry Agency. Wood utilization in Japan. Tokyo: Nippon Mokuzai Bichiku Kiko; **1984.** 53 p.

Jen, I.A. An economic analysis of supply and demand for logs in Taiwan. Bull. 363. Taipei: Taiwan Forestry Research Institute; **1982.** 10 p. [In Chinese with English summary].

Jen, I.A. Timber demand, supply and price fluctuations in Taiwan. In: Proceedings IUFRO symposium on forest management planning and managerial economics; 1984 October 15-19; Tokyo. Tokyo, Japan: University of Tokyo Department of Forestry; **1984:** 665-670.

Katsuhisa, Hikojiro. Forest products trade of Japan. In: The current state of Japanese forestry (III). Contributions to IUFRO, Division 4. Tokyo: The Japanese Forest Economic Society; **1984:** 10-28.

Lardy, Nicholas R. Agricultural prices in China. World Bank Staff Work. Pap. 606. Washington, DC: The World Bank; **1983.** 66 p.

New Zealand Forest Service. Forest planning division. The forestry sector in New Zealand. Wellington, NZ; **1980.** 61 p.

New Zealand Forest Service. Statistics of the forests and forest industries of New Zealand to 1983. Inf. Ser. 33. Wellington, NZ; **1984.** 100 p.

Nomura, Isamu. Long-term supply and demand prospects for forest products in Japan, and some comments. In: The current state of Japanese forestry (III). Contributions to IUFRO, Division 4. Tokyo: The Japanese Forest Economic Society. **1984:** 1-9.

Ogawa, Satoshi, ed. Japan's timber consuming industries, 1983. Tokyo: Japan Lumber Journal, Inc.; **1984.** 428 p.

U.S. Department of Agriculture, Foreign Agricultural Service. Chile: forest products report. Attache Rep. CI-3058. Washington, DC: **1983a.** 15 p.

U.S. Department of Agriculture, Foreign Agricultural Service. Forest products annual - Taiwan. Attache Rep. TW-3029. Washington, DC: **1983b.** 16 p.

U.S. Department of Agriculture, Foreign Agricultural Service. U.S.S.R.: annual forestry report, 1983. Attache Rep. UR-3150. Washington, DC: **1983c.** 19 p.

U.S. Department of Agriculture, Foreign Agricultural Service. U.S.S.R. forest products - annual. Attache Rep. UR-4100. Washington, DC: **1984.** 24 p.

U.S. Department of Commerce, International Trade Administration. Investment climate in foreign countries. Vol. 3, Asia. Washington, DC: Government Printing Office; **1983.** 301 p.

Ueda, Michihiko; Darr, David R. The outlook for housing in Japan in the year 2000. Res. Pap. PNW-276. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; **1980.** 25 p.

United Nations, Economic Commission for Europe and Food and Agriculture Organization. Forest and forest products. Country Profile U.S.S.R. Suppl. 5 to Vol. 33 of the "Timber Bulletin for Europe." Geneva; **1980.** 25 p.

United Nations, Food and Agriculture Organization. World forest products demand and supply, 1990 and 2000. FAO For. Pap. 29. Rome; **1982.** 366 p.

United Nations, Food and Agriculture Organization. Yearbook of forest products 1982. Rome: **1984.** 408 p.

World Bank. World development report 1984. New York: Oxford University Press; **1984.** 286 p.

World Bank. World development report 1985. New York: Oxford University Press; **1985.** 243 p.

Appendix

This section covers the mathematical formulation of demand and/or supply functions and their aggregation for individual countries.

Q is quantity in thousand cubic meters. Unless otherwise noted, a conversion of 5.5 cubic meters per thousand board feet (MBF), Scribner log scale, is appropriate.

$\underline{p}$ is price in local (non-U.S.) currency per cubic meter, c.i.f. the country's port, inflation-adjusted to 1983.

P is price per cubic meter in 1983 U.S. dollars, adjusted for shipping cost to f.a.s. North America; International Monetary Fund currency conversion factors are used unless otherwise indicated.

G is the country's gross national product (GNP) or gross domestic product (GDP), inflation-adjusted to 1983 prices, in units of currency shown with the equation.

Equations were developed by use of ordinary least squares. Shown in parentheses below the coefficients to which they apply are the "t" statistics. R^2 and DW are the coefficient of determination and the Durbin-Watson statistic, respectively. The country analyses were done in local currency, then equations were adjusted to f.a.s. and U.S. dollars.

Annual data were used throughout the analyses. Except as indicated, the sample period is 1963-82. Dummy variables were used to recognize major currency realignments and other major structural economic changes in log markets. Lagged variables were not used. Commonality was sought among the variables used for different nations. And variables were included only if a plausible means of forecasting them through 1995 was apparent. Overall, some explanatory power was sacrificed for simplicity. For example, Wiseman[1/] developed a demand equation for U.S. logs in Japan by using an 18-year data series and four predictive variables, achieving an R^2 of 0.98. The comparable equation in this study used two explanatory variables and yielded an R^2 of 0.78.

Japan

The demand equation for Japan is:

$$Q = 1528 - 0.0578\underline{p} + 3.51S$$
$$(-1.10) \qquad (4.07)$$

$R^2 = 0.78$; DW = 1.62; F = 14.

S = housing starts, in thousands.

$\underline{p}$ = hundred yen per cubic meter.

Adjusted from c.i.f. and local prices to f.a.s. and dollars, it is:

$$Q = 1201 - 13.87P + 3.51S.$$

The price elasticity of this function, at 1983 quantity and price, is -0.24.

[1/]Wiseman, A. Clark. The role of prices and foreign trade barriers in affecting the volume of United States forest products exports. 1983. Report on file. Seattle, WA: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Korea

The demand equation for Korea is:

$$Q = -1762 - 2393 \ln\underline{p} + 1393 \ln G$$
$$(-2.40) \qquad (3.58)$$

$R^2 = 0.77$; DW = 1.06; F = 15.

G = GDP in billion won.

Adjusted from c.i.f. to f.a.s., and from won to dollars, it is:

$$Q = -1762 - 2393 \ln(P + 25) + 1393 \ln G$$

G remains in billion won.

Data used were for 1971-82.

The projections of gross domestic product were 1.6 percent per year through 1985, and 5.5 percent per year thereafter (World Bank 1984).

Taiwan

Aggregate excess demand for imported logs was taken to be the difference between rising domestic consumption and falling domestic production. These components were estimated separately in the absence of historic evidence on softwood log imports.

With a "t" value of only 0.19 for the price coefficient, the demand equation was judged unfit for projections (the equation, using GNP as a shifter, had an F value of 17 and an R^2 of 0.81). Instead, a price elasticity estimate was based on another, in which elasticity (E) was between 0.7 and 1.3 (Jen 1982). A midpoint elasticity, 1.0, was used with the price and quantity for 1983 to formulate the local demand function:

$$\ln Q = 14.24 - 1.0 \ln\underline{p} + 0.055 N$$

$\underline{p}$ = NT$ per cubic meter.

N = date (year) minus 1983.

The variable N is a demand shifter developed from the assumptions that demand will increase in concert with gross national product and that GNP will increase 5.7 percent per year in real terms (World Bank 1984).

The corresponding f.a.s. function is:

$$\ln Q = 10.55 - \ln(P + 27.8) + 0.055 N$$

The local supply function for Taiwan is founded on that country's longstanding reliance on domestically grown softwoods, a source that is declining as is evidenced by rising prices and falling volumes sold. Analytically, the evidence is in a leftward-shifting supply curve:

$$\ln Q = 3.5112 + 0.31 \ln \underline{p} - 0.1158\ N$$
$$(2.38) \quad (-6.18)$$

$R^2 = 0.95$; DW = 2.70; F = 71.

$\underline{p}$ = Taiwan dollars per cubic meter;

N = date (year) minus 1983.

Adjusted to U.S. funds and f.a.s. supply, the equation is:

$$\ln Q = 4.6548 + 0.31 \ln(P + 37) - 0.1158\ N$$

The data were for 1971-81.

China

Assumptions described in the text produce this f.a.s. demand equation:

$$Q = K/(P + 27);$$

K = 280,000 in 1983; 430,000 in 1990; and 570,000 in 1995.

United States

The f.a.s. supply equation is:

$$\ln Q = 1.23 + 1.0 \ln P + 0.065C + 0.039N + 0.58D$$
$$(0.96) \quad (3.03) \quad (4.71) \quad (6.45)$$

$R^2 = 0.96$; DW = 2.85; F = 88.

C = Pacific Northwest timber cut, billion board feet;

N = date, year minus 1960;

D = dummy = 1 after 1966.

Soviet Union

The price-invariant function adds 1 percent per year to Soviet log exports into the Pacific area. For 1983 the quantity estimate is based on Soviet data reported by the USDA Foreign Agricultural Service (1984). The projected growth rate in exports is centered among various estimates bounded by the Soviet Eleventh Five-Year Plan (timber production increasing 0.5 percent per year) and an FAO estimate of export gains of 1.3 percent per annum (USDA Foreign Agricultural Service 1983c; United Nations, FAO 1982).

The resulting equation is:

$$\ln Q = 8.568 + 0.01\ N;$$

N = date (year) minus 1983.

New Zealand

The supply function for construction-grade log exports for New Zealand is:

$$\ln Q = 4.766 + 0.97 \ln \underline{p} + 0.00019C - 0.00018G - 0.415D$$
$$\qquad\qquad (0.65) \qquad (0.91) \qquad (-1.53) \qquad (-1.14)$$

$R^2 = 0.53$; DW = 1.03; F = 3.1.

Data period is 1968-83.

$\underline{p}$ = New Zealand dollars per cubic meter;

C = softwood log harvest, in thousand cubic meters;

G = GDP, 1980 prices, million New Zealand dollars;

D = dummy = 1 after 1975.

Harvest forecasts were drawn from a New Zealand Forest Service (1980) report.

The descriptive weakness of this equation, with particular regard to the price coefficient, should be noted. Exports have not been well correlated with log prices.

Because shipping costs to most Pacific Rim markets were assumed lower than, but not materially different from, rates from the U.S. west coast, a separate f.a.s. function was not needed.

Chile

Data for 1975-83 were used to develop a relationship between log export volume, harvest, and GDP:

$$Q = -515 + 0.276C - 0.734G$$
$$\qquad\qquad (2.56) \quad (-1.29)$$

$R^2 = 0.77$; F = 8.4.

C = industrial log consumption, assumed equal to harvest, in thousand cubic meters (Chile Instituto Forestal 1984a);

G = GDP at 1980 prices, in billion pesos.

Attempts to incorporate a price variable failed to produce statistically valid coefficients. Therefore a short-term price elasticity of 1.0 was imposed.

Projections of harvest were drawn from a study in Chile of radiata pine production trends (Chile Instituto Forestal 1984b). The World Bank (1984) provided the basis for assuming GDP growth of 1.9 percent annually to 1985 and 3.8 percent per year thereafter.

Ten percent of Chilean pine exports were assumed to be "structural" grade by 1990 and 12 percent in the more valuable "structural" category by 1995. Resulting export quantities are 15 to 30 percent higher than projected in the Chile mensurational study. The latter estimates, however, are derived from an assumption that 22 percent of saw logs in Chile will enter export markets. This is a lower fraction than was experienced prior to 1985. Certainly an urgent need for foreign exchange and static investment in domestic processing facilities will create pressure toward roundwood sales abroad.

Estimated harvests in Chile and export quantities at 1983 prices are:

	Harvest[2]	Export
	(Thousand cubic meters)	
1983	10,880	950
1990	17,710	2,460
1995	21,880	3,270

Canada

The supply function is:

$$\ln Q = 3.958 + 0.57 \ln P.$$

[2/]Chile Instituto Forestal (1984b).

Flora, Donald F.; Vlosky, Richard P. Potential Pacific Rim demand for construction-grade softwood logs. Res. Pap. PNW-364. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station; **1986.** 29 p.

Markets for small lower grade ("construction-grade"), softwood logs are projected to expand steadily through 1995. Log supplies will lag slightly behind demand until 1990, generating about a 10-percent increase in prices. Prices are expected to be level thereafter. United States exports of construction-grade logs are projected to increase 35 percent by 1990 and another 23 percent by 1995.

Keywords: Markets (external), supply/demand (forest products), trade (Pacific Rim).

Pacific Northwest Research Station
319 S.W. Pine St.
P.O. Box 3890
Portland, Oregon 97208

.S. Department of Agriculture
acific Northwest Research Station
19 S.W. Pine Street
O. Box 3890
ortland, Oregon 97208

BULK RATE
POSTAGE -
FEES PAID
USDA-FS
PERMIT No. G-4